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(54) Method and apparatus for moulding concrete

(57) The invention entails lining a mould cavity of a rigid mould (11) with a flexible liner (17) and filling with wet concrete. The rigid mould is removed, following inversion thereof on a rigid board, at the stage where the moulding is self supporting but still pliable. The liner itself is then taken off the moulding. The liner protects the moulding during removal of the rigid mould against damage by contact with the rigid mould and, due to its flexibility, permits the liner to be peeled off the moulding progressively to admit air between the liner and the moulding and this in turn facilitates removal of the liner without damage to the moulding.

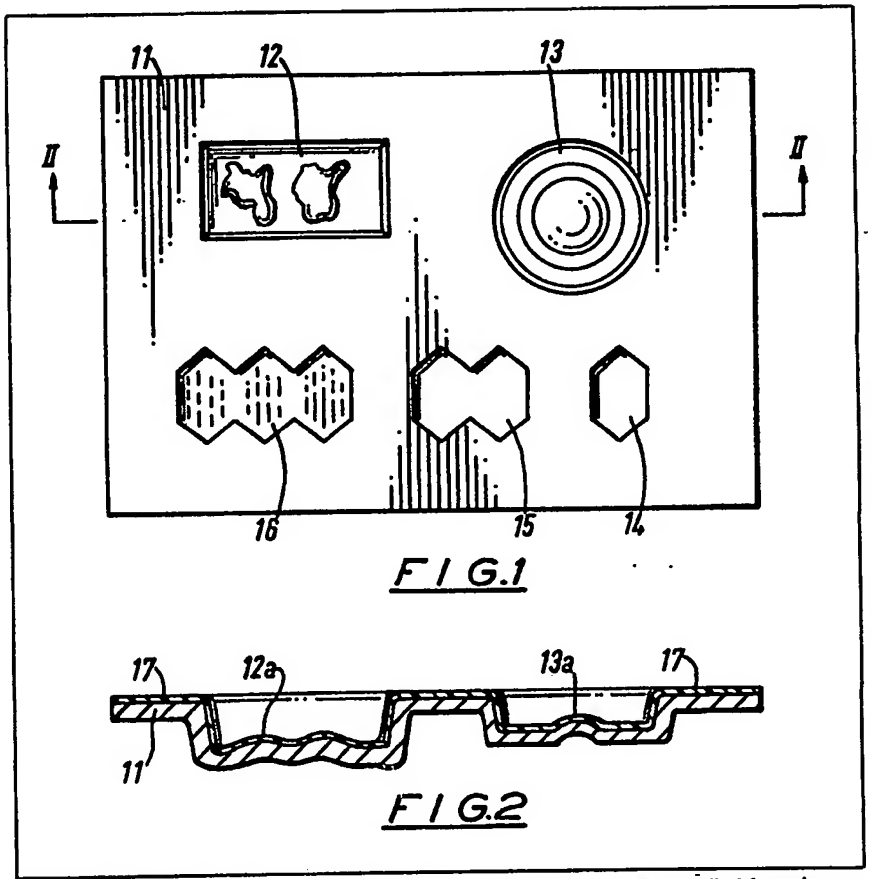

FIG.1

FIG.2

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

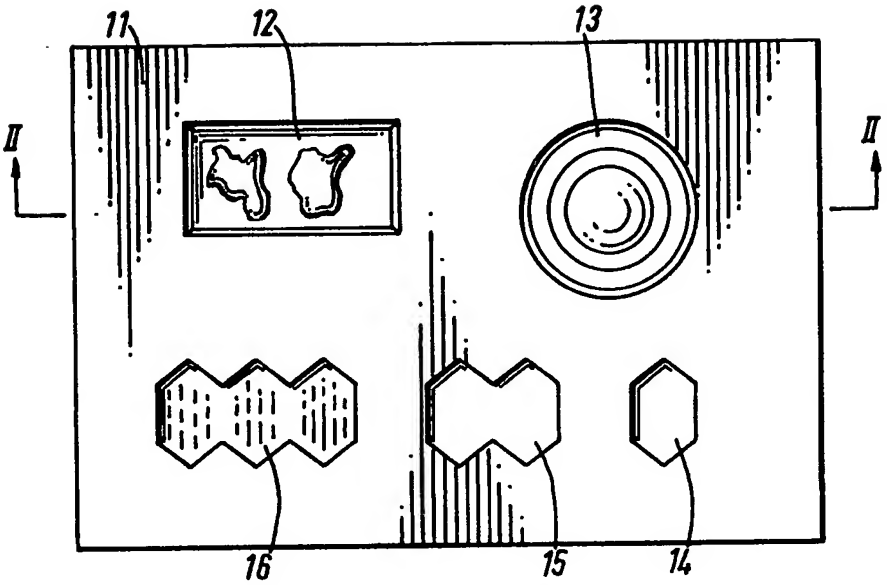

FIG.1

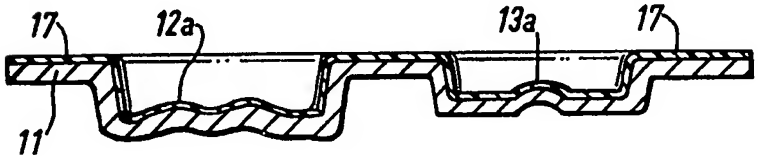

FIG.2

SPECIFICATION

Method and apparatus for moulding articles

This invention relates to a method and apparatus for moulding articles and, more particularly, to a method and apparatus for moulding cold setting materials.

It is well known in the art to mould articles in concrete, plaster, and the like cold setting materials by mixing the material consitituents with water, charging the wet mix into an upwardly open mould cavity, allowing the wet mix to set, and then separating the moulded article from the mould. The mould cavity surfaces must be of a relatively rigid material to impart the desired configuration to the wet mix and therefore the mould generally comprises a rigid body with the mould cavity formed in one face thereof.

When a wet mix such as concrete is charged into a mould cavity the mix material can be considered as passing through four stages as follows;

(1) That stage at which the mass is fluid and cannot retain shape or configuration without full support.

(2) That stage at which the material is self supporting and can maintain an imparted shape and configuration but is "soft" and readily deformable by contact.

(3) That stage at which the material is self supporting and has a resistance to deformation and,

(4) that fully dried or set stage when the article can be safely handled without damage thereto.

With concrete the stage (2) is generally attained some thirty minutes after the mould has been charged, stage (3) is attained some ten to twelve hours after the mould has been charged, and the stage (4) is safely attained some 24 to 48 hours after mould charging, depending upon the concrete mix.

As a mould of the type described above constitutes a capital investment it is uneconomical to allow the articles to dry or set to the stage (4) in the mould and, as the moulded articles must therefore be removed from the mould before stage (4) is achieved, it is the usual practice to remove the moulded article from a mould cavity by placing a backing board across the top of the mould to cover the mould cavity, inverting the backing board with the mould pressed firmly thereto, and then to lift the mould to leave the moulded article resting on the backing board where the article can continue to dry out and set until stage (4) is attained. The mould is removed manually simply by lifting the mould away from the backing board but as concrete exhibits little if any shrinkage between stage (1) and stage (3) the adhesion between the moulded article and the surfaces of the mould is only broken when air can flow between the moulded article and the mould and therefore during the initial separation of the article from the mould surfaces the article must have the internal strength to resist the forces applied thereto. Further, as the mould is displaced manually away from the backing board there is always the danger that the mould, after initial separation, will contact the article and, therefore, the article must have the inherent resistance to deformation to withstand mould contact. If the article is removed from the mould before the stage (3) is attained the article does not have the inherent strength to resist the forces at initial separation from the mould or the resistance to deformation by contact with the mould subsequent to initial separation and the resultant article will be damaged.

In view of the above it is the normal practice to effect separation of the moulded article from the mould only after the stage (3) drying or setting has been achieved.

The present invention seeks to provide a method and apparatus for moulding an article and whereby the moulded article can be safely removed from the rigid mould immediately the moulded article attains the stage (2) setting.

According to the present invention a method of moulding comprises the steps of lining a mould cavity in a substantially rigid mould with a flexible liner, charging the mould cavity with a cold setting mixture, allowing the mixture to set to a degree at which the mould charge is self supporting but deformable by contact, placing a backing plate over the cavity-containing face of the mould including the exposed face of the moulded article, inverting the backing board with the mould pressed firmly thereto, separating the solid mould from the flexible liner and then removing the flexible liner from the moulded article.

It will thus be seen that the present invention envisages separation of the substantially rigid mould from the liner at or subsequent to the mixture attaining the stage (2) setting or drying defined above so that the mould residence time is greatly reduced over the prior art method of moulding and the rate of moulding, per mould, can be greatly increased.

The present invention also envisages apparatus for moulding comprising a substantially rigid mould and a mould cavity liner of a flexible material.

Preferably the mould liner extends over at least part of the surface of the rigid mould containing the mould cavity and, when the rigid mould presents a plurality of mould cavities at one face thereof, each mould cavity may have a separate mould liner individual thereto but in an alternative arrangement the mould liners for two or more adjacent mould cavities may be connected together.

In this specification the term "substantially rigid mould" means a mould formed of a material which has such rigidity as to maintain a desired shape and configuration when charged with a wet mouldable mixture and, in a preferred embodiment, the mould is formed from a sheet of plastics material and the mould cavities are formed in said sheet by a vacuum forming process.

In the specification the term "flexible material" means a sheet material having little rigidity and in a preferred embodiment the mould liner comprises a relatively thin sheet of polythene with mould cavities formed therein, preferably by a vacuum forming process.

Preferably the rigid mould is perforated, at least in the regions of the mould cavities, to assist separation of the rigid mould from the flexible mould liner.

In a preferred embodiment in accordance with the invention that surface of the mould liner presented to the wet mix is treated to affect the wet mix by, for example, having attachments which will affect the shape and configuration of the wet mix, thus to allow a rigid mould with interchangeable mould liners to produce differently shaped moulded articles, or the liner may have panels of water based colourants applied thereto which will be softened by the water in the wet mix and absorbed into the moulded article to give a desired coloured effect to the moulded article.

The invention will now be described further by way of example with reference to the accompanying drawings in which:-

Figure 1 shows a plan view of a rigid mould having a plurality of mould cavities formed therein and,

Figure 2 shows a cross-section, on the line II–II in Fig. 1, with a mould liner applied to the mould.

In the illustrated example a mould 11, comprises a substantially rigid sheet of plastics material, with five mould cavities 12, 13, 14, 15 and 16 formed therein by a vacuum forming process.

The cavity 12 is a substantially rectangular cavity with an irregular base for producing stone-like facing blocks, the cavity 13 is a cylindrical cavity for moulding simple wall plaques, the cavity 14 is a substantially hexagonal cavity for producing ornamental facing blocks and the cavities 15 and 16 produce articles respectively having the appearance of two connected facing blocks produced from cavity 14 or three connected facing blocks produced from cavity 14. The cavities 13, 14, 15 and 16 may, in like manner to the cavity 12, have specially shaped bottoms to produce desired configurations in the moulded articles but in each and every case the cavity walls are inwardly inclined towards the base of the cavity, to facilitate separation of the mould from the articles moulded in the cavities, and the cavities do not have re-enterant surfaces as may obstruct the ready separation of the mould from the moulded articles.

As will be seen from Figs. 1 and 2 the mould 11 comprises a simple sheet of material with the mould cavities formed in one surface thereof, the sheet of material forming the mould 11 may be substantially rigid or the sheet material may have a degree of resilience so as to be flexible along planes which do not pass through a mould cavity but, particularly when vacuum formed, the mould cavities will individually afford the desired degree of rigidity to maintain the cavity shape and configuration when charged with a wet mix.

Moulds 11 of the type described above with a plurality of identical mould cavities, or differently shaped mould cavities, are well known in the art and the cavities 12, 13, 14, 15 and 16 shown in Figs. 1 and 2 are simply examples of the different shapes and configurations which may be included in a single mould 11. In conventional practice, the mould cavities 12, 13, 14, 15 and 16 are charged with a wet mix, the mould 11 is allowed to stand until the mould contents attain a stage (3) rigidity as defined above, a backing plate (not shown) conveniently a wooden panel, is placed across the top of the mould, covering the mould cavities 12, 13, 14, 15 and 16, the backing plate with the mould pressed thereto is inverted, and the mould 11 is stripped from the moulded articles to leave the moulded articles resting on the backing panel where they may be safely left to dry and set to the stage (4) condition.

The method proposed by the present invention requires each of the cavities 12, 13, 14, 15 and 16 to be lined with a flexible cavity liner and, as will be seen from Fig. 2, the cavities 12 and 13 are lined with cavity liners 12*a* and 13*a* respectively formed in a thin sheet 17 of polythene material. Although not illustrated it will be apparent that the cavities 14, 15 and 16 will be lined with cavity liners 14*a*, 15*a* and 16*a* respectively (not shown) formed in the sheet 17. Thus, a single sheet 17 will have the cavities 12*a*, 13*a*, 14*a*, 15*a* and 16*a* formed therein, conveniently by a vacuum forming process and, when applied to that surface of mould 11 presenting the open cavities 12 to 16 inclusive, the sheet 17 will snugly contact the whole of the said surface of mould 11, including the cavities, and the mould cavities will now be formed by the exposed surfaces of the sheet 17 defining the cavities 12*a*, 13*a*, 14*a*, 15*a* and 16*a*.

With the liner 17 snugly fitted against the mould 11 the cavities 12*a*, 13*a*, 14*a*, 15*a* and 16*a* may be charged with wet mixes, the mould charges may be of the same batch material or different batch materials, but when the cavities have been charged the mould 11 is left for that period of time required for the

slowest setting mixture to attain the stage (2) setting defined above when, in identical manner with that followed for the conventional practice, a backing board is placed across the top of the mould, covering all the mould cavities 12*a*, 13*a*, 14*a*, 15*a* and 16*a*, the backing board and the mould are inverted with the mould 11 pressed firmly against the backing board, and the mould 11 is then released. In practice the mould 11 is released from the liner 17 and the liner 17 is then peeled away from the moulded articles.

It will be observed that when the mould 11 is being removed the separation is effected between the mould 11 and the flexible sheet 17 so that adhesion between the moulded articles and the mould 11 is avoided, there is little adhesion between the sheet 17 and the mould 11, and the mould 11 is therefore easily and readily stripped from the flexible sheet 17. Further, whilst the moulded articles are in the stage (2) condition of setting so as to be self supporting but with little internal strength or resistance to damage by contact, when the mould 11 is being stripped the articles are contained by the flexible sheet 17 so that frictional damage between the moulded articles and the moulded 11 is avoided. Further, as the mould cavities 12*a*, 13*a*, 14*a*, 15*a* and 16*a* are fully charged with the moulded articles the flexible sheet 17, is supported by the moulded articles and forms a tough skin for the moulded articles so that the moulded articles within the sheet 17 are afforded some degree of protection against accidental contact with the mould 11 whilst the mould is being withdrawn.

Immediately after the mould 11 has been withdrawn the flexible sheet 17 may be peeled away from the moulded articles supported on the backing plate, in being relatively light and flexible the sheet 17, if it makes accidental contact with an exposed surface of an article, will not damage the article and as the sheet 17 is peeled away from the moulded articles so that air can continuously flow to the point of separation between the sheet 17 and the moulded articles the sheet 17 can be stripped from the moulded articles without damage to said articles and the said articles can then be left supported by the backing plate to pass through the stage (3) to the stage (4) setting condition.

Once the mould 11 has been stripped from the liner sheet 17 the mould 11 can be provided with a new sheet 17, or alternatively when the sheet 17 has been stripped from the moulded articles the said sheet 17 can be re-applied to the mould 11, and a new moulding operation can be initiated. By allowing the mould 11, and the sheet 17, to be freed from the moulded articles at or closely following setting of the mix to the stage (2) setting the residence time of the mix with the mould 11 is greatly reduced and the production rate per mould can be many times greater than can be obtained by using the mould 11 in the conventional manner.

To assist in separation of the mould 11 from the sheet 17 the mould 11 may be perforated, at least in the vicinity of the mould cavities 12, 13, 14, 15 and 16, and where the perforations are of small cross-section so as to aviod deflection of the liner 17 into the perforations the said perforations in the mould 11 will not affect the finish of the moulded articles. In fact, as the mould cavities receiving the wet mix are defined by the exposed surface of the sheet 17, the mould 11 may be made of a material unsuitable for direct contact with the wet mix and thus, for example, the mould 11 may be made of a porous or fibrous material.

It will also be appreciated that when the mould 11 is made from a perforated, porous or fibrous material the said mould 11 may be utilised as the mould for vacuum forming the sheet 17.

The liner 17 may be of uniform thickness, as illustrated, but in other embodiments of the invention the liner 17 may have flexible or rigid additions secured thereto so as to directly affect the shape and configuration of articles moulded in the cavities and thus, a single mould 11 may be used in combination with a plurality of interchangeable liners 17 to produce articles of different configuration. Further, the liner 17 may have materials applied thereto, such as water based colourants, intended to be affected by the wet mix and absorbed into the surface of the moulded articles.

Whilst the present invention has been described by way of example with reference to a specific embodiment as illustrated in the accompanying drawings it will be appreciated that many modifications and variations will be apparent to persons skilled in the art.

CLAIMS:

1. Apparatus for moulding a cold setting mixture comprising a substantially rigid mould and a mould cavity liner of a flexible material.

2. Apparatus according to claim 1, wherein the mould liner extends over at least part of that surface of the rigid mould containing the mould cavity.

3. Apparatus according to claim 1 or 2, wherein, in the case where the rigid mould presents cavities at one face thereof, each mould cavity has a mould liner which is individual thereto and separate from the liner or liners for the other cavity or cavities; or the mould liners for two or more adjacent mould cavities are connected together.

4. Apparatus according to any of claims 1 to 3, wherein the mould is formed from a sheet of plastics material and the mould cavities are formed in said sheet by a vacuum

forming process.

5. Apparatus according to any of claims 1 to 4, wherein the mould liner comprises a sheet of polythene with mould cavities formed therein.

6. Apparatus according to any one of claims 1 to 5, wherein the rigid mould is perforated, at least in the regions of the mould cavities, to assist separation of the rigid mould from the flexible mould liner.

7. Apparatus according to claim 5 or 6, wherein the mould cavities are formed by a vacuum forming process.

8. Apparatus as claimed in any of claims 1 to 7, wherein that surface of the mould liner presented to the wet mix is treated to have an affect on the wet mix.

9. Apparatus as claimed in claim 7, wherein the mould liner has attachments to affect the shape and configuration of the wet mix, thus to allow a rigid mould with interchangeable mould liners to produce differently shaped moulded articles.

10. Apparatus according to claims 8 or 9, wherein the mould liner has panels of water based colourants applied thereto which will be softened by the water in the wet mix and absorbed into the moulded article to give a desired coloured effect to the moulded article.

11. Apparatus for moulding a wet mix substantially as hereinbefore described with reference to the accompanying drawings.

12. A method for moulding comprising the steps of lining a mould cavity in a substantially rigid mould (as hereinbefore described) with a flexible liner, charging the mould cavity with a cold setting mixture, allowing the mixture to set to a degree at which the mould charge is self supporting but deformable by contact, placing a backing plate over the cavity-containing face of the mould including the exposed face of the moulded article, inverting the backing board with the mould pressed firmly thereto, separating the solid mould from the flexible liner and then removing the flexible liner from the moulded article.

13. A method as claimed in claim 12, wherein the mould liner extends over at least part of that surface of the rigid mould containing the mould cavity.

14. A method as claimed in claim 12 or 13, wherein, in the case where the rigid mould presents a plurality of mould cavities at one face thereof, each mould cavity has a mould liner which is individual threrto and separate from the liner or liners for the other cavity or cavities; or the moulded liners for two or more adjacent mould cavities are connected together.

15. A method according to any one of claims 12 to 14, wherein the mould is formed from a sheet of plastics material and the mould cavities are formed in said sheet by a vacuum forming process.

16. A method as claimed in any of claims 12 to 15, wherein the mould liner comprises a sheet of polythene with mould cavities formed therein by a vacuum forming process.

17. A method as claimed in any of claims 12 to 16, wherein the rigid mould is perforated, at least in the regions of the mould cavities, to assist separation of the rigid mould from the flexible mould liner.

18. A method as claimed in claim 16 or 17, wherein the mould cavities are formed by a vacuum forming process.

19. A method as claimed in any of claims 12 to 18 inclusive, wherein that surface of the mould liner presented to the wet mix is treated to have an affect on the wet mix.

20. A method as claimed in claim 19, wherein the mould liner has attachments to affect the shape and configuration of the wet mix, thus to allow a rigid mould with interchangable mould liners to produce differently shaped moulded articles.

21. A method as claimed in claims 19 or 20, wherein the mould liner has panels of water based colourants applied thereto which will be softened by the water in the wet mix and absorbed into the moulded article to give a desired coloured effect to the moulded article.

22. A method as claimed in claim 11 for moulding a wet mix substantially as hereinbefore described with reference to the accompanying drawings.

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